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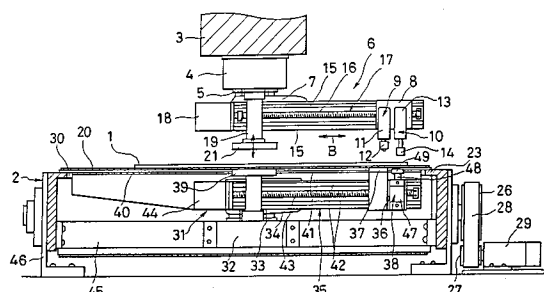
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London WC1R 5EU(GB)(54) **DEVICE FOR CUTTING GLASS PLATE.**

(57) A device for cutting a glass plate, which device is capable of cutting even a thick glass plate resistant to cracking (development of split), along a cutting line. The device comprises: a sucking disk unit (21) to lift the glass plate (1); a support table (39) to support the glass plate flat; cutting mechanisms (9, 10); a first transfer unit to transfer said cutting mechanisms on the polar coordinate plane on the glass plate surface; a glass plate receiving body (37) to support the glass plate in a position opposite to said cutting mechanisms and a cracking unit (38) to exercise cracking; a second transfer unit to transfer said glass plate receiving body and cracking unit on the polar coordinate plane on the glass plate surface; and a control unit to control cutting operation of the cutting mechanisms, operation of the first and second transfer units, and cracking operation of the cracking unit.

FIG. 1



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FIELD OF THE ART

The present invention relates to an apparatus suitable for breaking unshaped plate glass to form a car pane, etc.

BACKGROUND ART

Currently, cars are becoming deluxe increasingly, and hence the panes applied to them are becoming gradually thicker, and for example, have a thickness of five to six millimeters.

In a conventional apparatus for breaking plate glass, plate glass on which a cutting line is formed is put on a templet through a belt, and pressed to be broken forcibly by an end cutter or a press device. However, when the plate glass is thick as described above, enough crack is not developed or does not advance although the cutting line is given on the glass by means of stronger cutter pressure. In the forcible breaking by the above conventional breaking apparatus, there is undesirable case where the glass is not broken well along the cutting line, but chipped, or sometimes not cracked and remains unbroken. In such case, good products would not be produced even if the polishing work or other works are performed in the following processes.

In view of the above, it is an object of the present invention to provide an apparatus for breaking plate glass which makes cracks in the glass and then breaks the glass even if the glass in which enough crack does not develop is supplied to the apparatus.

The other object of the present invention is to provide an apparatus for breaking glass plate which eliminates the use of a templet that the conventional apparatus for breaking requires.

DISCLOSURE OF THE INVENTION

According to the present invention, the above object is achieved by an apparatus for breaking plate glass, comprising a belt conveyor which includes a belt on which the plate glass is put and which travels the belt, a breaking mechanism disposed above the belt conveyor for pushing and breaking the plate glass put on the belt at a portion formed with a cutting line on the plate glass, a first moving device provided between the breaking mechanism and the belt for relatively moving the breaking mechanism to the plate glass along a surface of the plate glass which is put on the belt, a lifter provided above the belt conveyor for lifting the plate glass which is put on the belt, a supporting base for supporting in plane the plate glass put on the belt through the belt, a glass support provided movably at a back surface of the belt for

supporting the plate glass through the belt, a crack developing device provided movably at the back surface of the belt for developing a crack into the plate glass through the belt, a second moving device for moving the glass support and the crack developing device along the surface of the plate glass at the back surface of the belt, and a control device for controlling the breaking operation of the breaking mechanism, the operation of the first and the second moving devices, and the crack developing operation of the crack developing device, the control device controlling the second moving device so as to move the glass support and the crack developing device to a position facing to the position where the breaking mechanism is moved.

In one embodiment, the breaking mechanism according to the present invention comprises an end cutter for forming a cutting line for an end cutting on the plate glass which is put on the belt and a press device for pressing the glass plate in the vicinity of a portion of the plate glass on which the cutting line is formed to thereby break that portion of the glass formed with the cutting line.

According to the present invention, the above object is also achieved by an apparatus for breaking plate glass, comprising a belt conveyor which includes a conveyor belt on which the plate glass is put, a pressing and breaking device provided above the belt conveyor for pressing and breaking the plate glass, the pressing and breaking device being moved parallel to and above an upper surface of the belt conveyor to end-cut or press the plate glass on the belt conveyor, a suction device provided above the belt conveyor and moved toward and away from the upper surface of the belt conveyor to suck and lift the plate glass, a supporting base provided below the conveyor belt for supporting the plate glass in plane through the belt, a rotation and drive device having a rotating central shaft disposed perpendicular to an upper surface of the supporting base, the rotation center of the shaft being in the supporting base, a linear-sliding device mounted on the rotation and drive device and having a slider which is moved linearly in a radial direction, a glass support attached to the slider of the linear-sliding device, a crack developing device mounted on the slider and actuated by an air cylinder for knocking or pressing the glass plate at the surface of the glass plate opposite to the surface of the plate glass on which the cutting line is formed, and a control device for positioning the glass support and the crack developing device at a position corresponding to the position where the end cutting operation or the pressing operation in the breaking apparatus are performed for the plate glass.

The present invention is also applicable to the apparatus for breaking other kinds of plate glass,

for example, table top glass, and not limited to the car pane.

The apparatus for breaking plate glass according to the present invention may be so arranged that the breaking operation and conveyance of the plate glass are performed on the basis of the numerical control system.

The present invention will be described hereinafter in more detail with respect to the embodiments thereof shown in the drawings. By this description, the above invention and its advantages as well as other inventions and their advantages will be clarified.

BRIEF DESCRIPTION OF DRAWINGS

Fig. 1 is a front view of a breaking apparatus according to the present invention; and

Fig. 2 is a plan view of the breaking apparatus shown in Fig. 1.

BEST MODE FOR CARRYING OUT THE INVENTION

Referring to Figs. 1 and 2, a first angle motor 4 is secured to a frame 3, which is provided above a conveyor belt 20 of belt conveyor 2 on which plate glass 1 is put, above the center of the belt conveyor 2, i.e., above the center of the plate glass 1 that is put on the belt. The first angle motor 4 is so secured that the rotating shaft thereof is perpendicular to an upper surface of the conveyor belt 20 of the belt conveyor 2. A first linear-sliding device 6 is attached directly or through a bracket 7 to a movable member 5 connected to the rotating shaft of the first angle motor 4. The first linear-sliding device 6 is rotated in the direction A parallel to the plate glass 1 above the belt conveyor 2 by the actuation of the first angle motor 4, and a slider 8 of the device 6 is moved linearly in the direction B, i.e., parallel to the plate glass 1. An end cutter 9 and a press device 10 as a breaking mechanism are secured side by side to the slider 8 of the first linear-sliding device 6, facing the belt conveyor 2. Therefore, the end cutter 9 and the press device 10 are moved in steps and positioned in a polar coordinate system above the belt conveyor 2, in other words, parallel to and above plate glass 1 by the actuation of the first angle motor 4 and the first linear-sliding device 6.

Besides, the end cutter 9 and the press 10 may be moved in a X-Y orthogonal coordinate system instead of a polar coordinate system.

The end cutter 9 is so adapted that a cutter wheel block 12 is attached to an end of the piston rod of an air cylinder 11 that is moved toward or away from the plate glass 1. The press device 10 is so adapted that a push bar 14 is attached to an

end of the piston rod of an air cylinder 13 that is also moved toward or away from the plate glass 1. The first angle motor 4 composed of a motor with the rotating position detector is connected to a drive unit and a controller and the like, and is subjected to digital servo control by a control device (not shown). The control device of the first angle motor 4 also includes an information memory for position instruction inputs, speed instruction inputs, a memory reader, and so on.

The linear-sliding device 6 generally comprises a driver 17 which includes a guide rail 15 and a threaded shaft 16, and a servo motor 18 connected to the threaded shaft 16. The slider 8, which is screwed over the threaded shaft 16 is servo-fed such as step driving and the like by the actuation of the servo motor 18 by the control device. The control device, which controls the servo motor 18 includes the memory write unit, the memory reader, the teaching receiver, the data sender, CPU and so on.

A fixed hollow tube 19 is disposed at the center of rotation of the first angle motor 4. A suction device 21 which is moved toward or away from the conveyor belt 20 of the belt conveyor 2 is secured to the hollow tube 19. The suction device 21 lifts the plate glass 1, outer (edge) part 22 of which is broken away, to separate the cullet on the conveyor belt 20 of the belt conveyor 2. The separated cullet is discharged out by the conveyor belt 20.

The belt conveyor 2 comprises a conveyor belt 20 on which the plate glass 1 is put, a supporting plate 23 for flatly supporting a lower surface of the conveyor belt 20, drums 24 and 25 around which a conveyor belt 20 extends, and pulleys 26, 27, a belt 28 and a motor 29 for rotating the drum 24 to run the conveyor belt 20. The supporting plate 23 is bored in the form of a circle in correspondence to an area where the plate glass is put, and a device 3 for supporting plate glass is provided in the bore 30.

Concerning the supporting device 31 for plate glass, a second angle motor 32 is disposed at the center of the device. A second linear-sliding device 35 is attached through a bracket 34 to a rotating part 33 connected to the output rotating shaft of the second angle motor 32 and is parallel to an upper surface of the conveyor belt 20. A glass support 37 which supports the plate glass 1 through the conveyor belt 20 as well as a crack developing device 38 which develops crack along a cutting line 60 of the plate glass 1 are attached to the slider 36 of the second linear-sliding device 35.

An upstanding supporting base 39 which supports the plate glass 1 and the conveyor belt 20 in plane is mounted on the central fixed part of the second angle motor 32. An upper surface of the

supporting base 39 is almost flush with the supporting plate 23 which supports the conveyor belt 20. The central axis of rotation shaft of the second angle motor 32 is perpendicular to the supporting base 39 and the supporting plate 23. The second linear-sliding device 35 secured to the rotating part 33 directly or through the bracket 34 is rotated in a plane parallel to the upper surface of the supporting base 39 as well as the upper surface of the conveyor belt 20 of the belt conveyor 2, and around the supporting base 39 horizontally in a controlled manner.

A belt supporting plate 40 which supports the conveyor belt 20 is held by the linear-sliding device 35 so as to be rotated in the direction A together with the sliding device 35. The belt supporting plate 40 is formed with a cutout 41 extending along a moving path in the direction B of the glass support 37 as well as the crack developing device 38.

The second angle motor 32 has the same function as the first angle motor 4 of the breaking section and, of course, is controlled in driving operation thereof by the control device. The second linear-sliding device 35 that comprises a rail 42, a threaded shaft 43 screwed into the slider 36, and a motor 44, the output rotating shaft of which is connected to the threaded shaft 43 has the same function as the first linear-sliding device 6, and is similarly controlled by the control device in driving operation thereof.

The second angle motor 32 is held by a conveyor frame 46 through a bracket 45. The slider 36 of the second linear-sliding device 35 is moved in sequence to the required position under the plate glass 1, i.e., under the cutting line in a polar coordinate system by a linear movement in the direction B and by angle movement in the direction A of the second angle motor 32 numerically controlled by the control device.

The slider 36 of the second linear-sliding device 35 is equipped with the glass support 37 which supports the plate glass 1 in plane and the crack developing device 38 which is secured in juxtaposition with the glass support 37. The upper surface of the glass support 37 is planar and almost flush with the supporting base 39. On the other hand, the crack developing device 38 comprises an air cylinder device 47 attached to the slider 36 through a bracket, and a knocker 49 fixed to a piston rod 48 of the air cylinder device 47 so as to knock a lower surface of the plate glass 1 which is supported by the supporting base 39. In order to develop a crack, the air cylinder device 47 is actuated intermittently to cause the knocker 49 to knock the plate glass under the cutting line.

Another arrangement for developing cracks may be such that a roller (not shown) is attached

rotatably to the piston rod 48 of the air cylinder device 47 instead of the knocker 49, wherein the roller is pressed against the plate glass 1 through the conveyor belt 20 by the actuation of the air cylinder device 47, and is caused to follow the cutting line below the plate glass to develop a crack under the control of the second angle motor 32 and the second linear-sliding device 35.

In the state where the plate glass 1 put on the belt conveyor 2 is pressed and fixed by the supporting base 39 of the supporting device 31 and the suction device 21 of the breaking section, the end cutter 9 and the press device 10 are positioned in sequence at a previously stored position by rotation in the direction A around the center of the plate glass 1 under actuation of the first angle motor 4 and a linear movement in the direction B under actuation of the first linear-sliding device 6 above the plate glass 1 and then perform an end cutting operation and a pressing operation. During these operations, the glass support 37 of the supporting device 31 and the crack developing device 38 is moved in a polar coordinate system on the basis of the previously stored program to support the plate glass from below the same which is subjected to the end cutting or pressing operation.

To sum up, the glass support 37 is moved in accordance with the movement of the end cutter 9 and the press device 10, in line with the program previously memorized.

According to the present invention as described above, when thick plate glass 1 with a cutting line in which the crack is developed insufficiently, is supplied to above the conveyor 2, the crack is firstly developed by the crack developing device 38 at the portion of the plate glass 1 where the crack is developed insufficiently, and then the breaking operation is performed by operating the breaking mechanism which includes the end cutter 9 and the press device 10. Namely, in the state where the plate glass 1 is supported at the center thereof by the supporting base 39 through the conveyor belt 20 as well as pressed and fixed by the supporting base 39 and the suction device 21, the crack developing device 38 of the supporting device 31 for plate glass is moved to the place on the glass where the crack is insufficient. At the same time, the press device 10 of the breaking mechanism above the conveyor 2 is moved to the position opposite to the position where the crack developing device 38 is placed. Under such conditions, the plate glass 1 is pressed from above slowly by the press device 10 by actuating the same, and the crack developing device 38 is actuated under the plate glass 1 to knock the plate glass 1 from below to thereby develop a crack in the cutting line on the glass. After the process of developing a crack is completed, the end cutter 9

and the press device 10 are positioned in sequence at the previously stored position above the plate glass 1 by rotating around the center of the plate glass 1 under actuation of the motor 4 and the linear movement under actuation of the linear-sliding device 6 and perform an end cutting operation and a pressing operation. During these operations, the glass support 37 of the supporting device 31 is moved in a polar coordinate system in accordance with a program previously stored to support from below the portion of the plate glass 1 where the end cutting operation or pressing operation is performed. In this way, the end cutting or pressing operation is performed on the plate glass to break same along the cutting line 60.

In this way, even thick plate glass 1 difficult to develop the crack is broken fine along the cutting line 60.

Claims

1. An apparatus for breaking plate glass, comprising belt conveyor which includes a belt on which the plate glass is put and which travels the belt; a breaking mechanism disposed above the belt conveyor for pushing and breaking the plate glass put on the belt at a portion formed with a cutting line on the plate glass; a first moving means provided between the breaking mechanism and the belt for relatively moving the breaking mechanism to the plate glass along a surface of the plate glass put on the belt; a lifter provided above the belt conveyor for lifting the plate glass put on the belt; a supporting base for supporting in plane the plate glass put on the belt through the belt; a glass support provided movably under the belt for supporting the plate glass through the belt; a crack developing device provided movably at the under surface of the belt for developing a crack into the plate glass through the belt; a second moving device for moving the glass support and the crack developing device along the surface of the plate glass at the under surface of the belt; a control device for controlling the breaking operation of the breaking mechanism, the moving operation of the first and the second moving devices, and the crack developing operation of the crack developing device, the control device being so adapted to control the second moving device to move the glass support and the crack developing device to a position facing to the position where the breaking mechanism has moved.
2. An apparatus as claimed in claim 1, wherein the breaking mechanism comprises an end cutter for forming a cutting line for an end cutting on the plate glass put on the belt and a press device for pressing the glass plate in the vicinity of the portion of the plate glass on which the cutting line is formed to thereby break the glass.
3. An apparatus for breaking plate glass, comprising a belt conveyor which includes a belt on which the plate glass is put; a plate glass pressing and breaking device provided above the belt conveyor for end-cutting or pressing the plate glass on the belt conveyor, the pressing and breaking device being moved parallel to an upper surface of the plate glass and above the belt conveyor; a suction device provided above the belt conveyor for moving toward or away from the upper surface of the belt to suck and lift the plate glass; a supporting base provided below the conveyor belt for supporting the plate glass in plane through the belt; a rotation and drive device having a rotating central shaft disposed perpendicular to an upper surface of the supporting base, the rotating central shaft being in the supporting base; a linear-sliding device mounted on the rotation and drive device and having a slider which is moved linearly in a radial direction; a glass support attached to the slider of the linear-sliding device; a crack developing device mounted on the slider and actuated by an air cylinder for knocking or pressing the glass plate at the surface of the glass plate opposite to the surface of the plate glass on which the cutting line is formed; and a control device for positioning the glass support and the crack developing device at a position corresponding to the position where the end cutting operation or the pressing operation in the breaking apparatus are performed for the plate glass.

FIG. 1

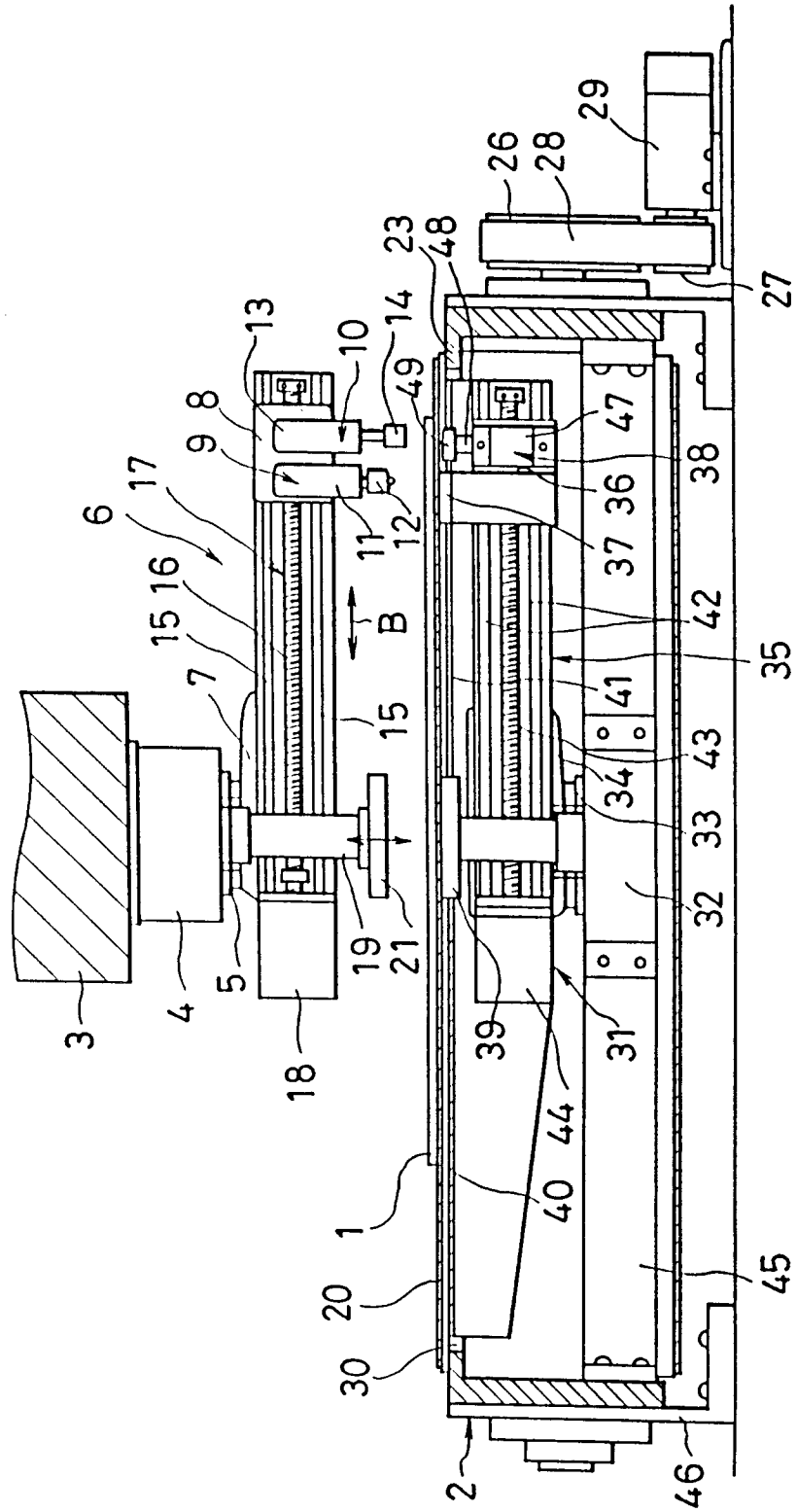
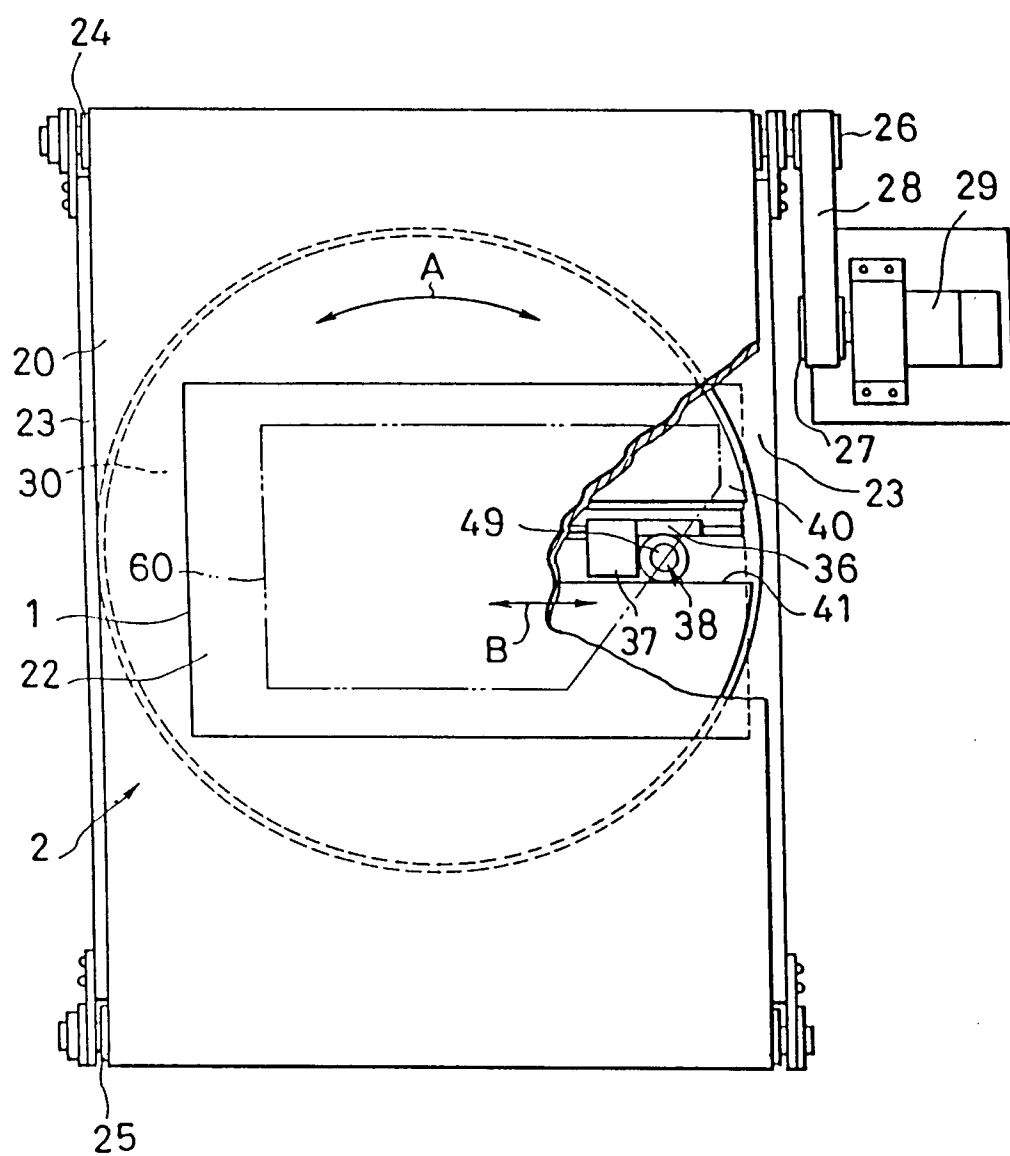


FIG.2



INTERNATIONAL SEARCH REPORT

International Application No PCT/JP91/00893

I. CLASSIFICATION OF SUBJECT MATTER (if several classification symbols apply, indicate all) ⁶		
According to International Patent Classification (IPC) or to both National Classification and IPC		
Int. Cl ⁵ C03B33/03, 33/033, 33/037		
II. FIELDS SEARCHED		
Minimum Documentation Searched ⁷		
Classification System	Classification Symbols	
IPC	C03B33/03-33/037	
Documentation Searched other than Minimum Documentation to the Extent that such Documents are Included in the Fields Searched ⁸		
Jitsuyo Shinan Koho 1926 - 1990 Kokai Jitsuyo Shinan Koho 1971 - 1990		
III. DOCUMENTS CONSIDERED TO BE RELEVANT ⁹		
Category [*]	Citation of Document, ¹¹ with indication, where appropriate, of the relevant passages ¹²	Relevant to Claim No. ¹³
A	JP, A, 54-70315 (Filmawellnar Shuprenk Machine und Verukzoicvau), June 6, 1979 (06. 06. 79), Claim, lines 8 to 12, upper left column, page 3, drawing & DE, B1, 2731230 & ZA, A, 7803930 & GB, B2, 2000759 & FR, B1, 2397369 & IT, A, 1104998	1-3
A	JP, B2, 1-37337 (Bando Kiko Co., Ltd.), August 7, 1989 (07. 08. 89), Claim, Figs. 2, 3 (Family: none)	1-3
[*] Special categories of cited documents: ¹⁰ "A" document defining the general state of the art which is not considered to be of particular relevance "E" earlier document but published on or after the international filing date "L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified) "O" document referring to an oral disclosure, use, exhibition or other means "P" document published prior to the international filing date but later than the priority date claimed "T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention "X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step "Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art "d" document member of the same patent family		
IV. CERTIFICATION		
Date of the Actual Completion of the International Search		Date of Mailing of this International Search Report
September 25, 1991 (25. 09. 91)		October 14, 1991 (14. 10. 91)
International Searching Authority		Signature of Authorized Officer
Japanese Patent Office		